(D 3)

PATENT SPECIFICATION

DRAWINGS ATTACHED

885,367

Date of Application and filing Complete Specification:
March 11, 1960.
No. 8632/60.
Application made in Sweden on March 14, 1959.
Complete Specification Published December 28, 1961.

Index at Acceptance: Classes 83(2), A166; 83(3), K8; and 83(4), 02F.
International Classification: B23p. B23c,d.

Improvements in or relating to the production of blade wheels.

COMPLETE SPECIFICATION

We, SVENSKA ROTOR MASKINER AKTIEBOLAG, a Joint Stock Company organized under the laws of Sweden, of Nacka, Sweden, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the production of blade wheels, for example for turbines, pumps and the like.

The manufacture of blade wheels comprising a disc provided with at least one ring of axially extending blades, and a ring interconnecting the blade ends remote from the disc, has hitherto been an intricate and expensive operation. For example one method of manufacturing blade wheels of this kind has been to make the disc and the ring and also the different blades as separate elements and subsequently to assemble them into one unit by riveting. In this method it has been necessary to provide each blade with at least one pin on each end and to drill holes in the disc and in the ring corresponding to said pins. The holes in the disc must be formed by boring, and thus great accuracy has been necessary to obtain exact pitch and exact blade angles. The pins have to be made by turning each blade separately.

Another method has been to produce a blank in the shape of a disc provided with a continuous annular axial projection from which the blades are to be cut. In this method the following machining steps have been necessary.

Firstly a turning operation of the disc of the blank to enable the blank to be set up for the milling operations. These comprise a rough-milling operation to cut away most of the material between the blades and a following finishing cutting operation during which the machining allowance is different at different parts of the blade.

(Price 4s. 6d.)

Due to the removal of part of the annular projection by the milling operation the distribution of the stresses of the blank is changed, so that the disc becomes somewhat distorted. The disc for said reason has to undergo a further turning as a finishing operation.

This method is both time-consuming and expensive as it necessitates milling in at least two steps by different milling cutters and two quite separate turning operations.

The object of the present invention is to produce a blade wheel of the axial blade type by a method which is considerably simplified over prior known methods.

According to the present invention a method of producing a blade wheel comprising a disc having at least one ring of axially projecting blades consists in casting a blank in the form of a disc provided with a ring of separate axially extending projections, each conforming to but of slightly greater dimensions that the finished blade, turning the disc to final shape, and cutting the whole length of each blade in a single operation by a milling cutter that extends over the whole length of the blade and is controlled by a pattern in directions transverse to the axis of the wheel.

Owing to the necessity of subsequent machining it is advisable to use a casting method giving limited tolerances and only slight hard skin or no hard skin at all, for example shell casting, so that the wear of the cutters as well as the machining time is reduced. To enable the attachment of a ring to the free ends of the blades it is further desirable to use a material soft enough to allow rivetting, such as nodular cast iron.

The blank produced in this way will at first be turned in one single turning operation to the desired dimensions of the disc. Then each blade is cut along the whole of its length in a single operation by a milling cutter which is controlled in its movement in directions transverse to the axis of the wheel

by means of a pattern or former.

By this method several considerable advantages are obtained compared with the method above referred to wherein the blade projections consist initially of one single annular projection.

In the first place, the rough milling necessary by the prior method is eliminated so that the milling can be done in a single step without change of cutter.

Secondly, with the method according to the invention a machining allowance of the projection is obtained which is approximately the same all around the blade while with the earlier method the machining allowance had to vary from one point of the blade to any other since the rough milling cannot follow the profile of the blade. As the removal of material is the same all around the blade there is a steady stress on the cutter so that it can be used in a very rational manner with a regular feed. The machining time of the cutter for this reason is as short as possible, and the cost of the milling is also reduced to a minimum.

Further by casting the blade projections separate from each other, the cutting off of parts of an annular projection of the blank is avoided so that the distribution of the stresses of the blank is unaltered and all distortion of the disc owing to change of stresses is avoided. The disc for this reason may be completely turned in a single operation before milling and any subsequent turning after milling is unnecessary.

It has proved to be advantageous to form the blades so that in different sections parallel to the disc they are of uniform profile but increase in dimension towards the disc. Thus the projections during casting have an advantageous angle of clearance, and the resistance of the blades is increased in the direction towards the disc without affecting appreciably the flow of fluid in the finished blade wheel.

Further, it is necessary to provide the blade ends, that is the blade ends remote from the disc—with pins for securing a ring interconnecting the blade ends. It has proved advantageous to make the cast blank with pin-like projections at the end of the blade projections, each of the projecting pins then being machined along two of its side surfaces during the milling of the profile of the associated blade and cylindrically along its other two side surfaces by a turning operation common for all blades. By said turning operation the blade ends are machined as well as the circumferential surfaces of the pins being turned.

The rings formed with holes corresponding to the pins are preferably made by punching in a single operation, the parts of the tool corresponding to the pin holes being manufactured by turning an annular projection which is then divided by milling into pins corresponding to the different holes. In this way the punching tool will be comparatively cheap to manufacture. On punching, the holes become slightly conical, which, however, is advantageous in that the blade pins after application of the ring are clinched, the pins being deformed to provide slightly conical heads which are advantageous for sure retention of the ring.

According to the dimensions of the ring connecting the blade tops, and especially its thickness, it is not always possible to form the holes by punching. In this case the holes must be drilled and the pins of the blades formed of cylindrical shape. The manufacture of said cylindrical pins is made by a drilling tool producing a cylindrical pin instead of a cylindrical hole, said tool being preferably located on the milling machine, so that the pin can be drilled in a first operation and the blade profile can be cut as described above in a second operation.

The invention also includes blade wheels manufactured according to the described method. Blade wheels of this kind are especially suitable for hydraulic transmissions, wherein several blade rings having a large number of blades are arranged, and where it is important to reduce the cost of the comparatively expensive blade systems as much as possible in order to obtain prices competitive with those of other types of transmission.

The invention will be hereinafter described more in detail by way of example with reference to the accompanying drawings in which:

Fig. 1 shows a longitudinal section through a wheel constructed according to the invention.

Fig. 2 is a partial transverse view of the wheel of Fig. 1.

Fig. 3 shows a longitudinal section through a mold for casting a wheel constructed according to the invention.

Fig. 4 is a partial cross section through the mould shown in Fig. 3.

Referring to Figs. 1 and 2, reference numeral 10 denotes a disc provided with a ring of blade projections 11 or blades 12, each provided with a pin 14. Each blade projection 11 is cut along the whole length of the blade in a single operation by a milling cutter 13. The pins 14 are formed with side surfaces 16 and 18 which coincide with the side surfaces 20 and 22 of the blades 12 and are machined to final shape together with said blades. The cylindrical surfaces 24 and 26 are machined to final shape by a turning operation around the axis of the disc 10.

Figs. 3 and 4 show a mould suitable for the casting of the wheel and comprising two main parts 32 and 34. In the part 34 a

number of profiled pices 36 are arranged which are made of synthetic resin or other suitable material and are provided with recesses in opposite faces, the two recesses of each piece corresponding to the halves of two consecutive blades provided with additions giving machining allowance. The profiled pieces 36 are arranged in an annular recess 38 in the part 34 and adjacent pieces form moulds for blade projections. The part 34 is also provided with a gate 40.

WHAT WE CLAIM IS:

1. A method of producing a blade wheel comprising a disc having at least one ring of axially projecting blades which consists in casting a blank in the form of a disc provided with a ring of separate axially extending projections, each conforming to but of slightly greater dimensions than the finished blade, turning the disc to final shape, and cutting the whole length of each blade in a single operation by a milling cutter that extends over the whole length of the blade and is controlled by a pattern in directions transverse to the axis of the wheel.

2. A method according to claim 1 in which the casting is effected by a method such as shell casting adapted to produce no hard skin on the blank.

3. A method according to claim 1 or 2 in which the disc is made of nodular cast iron.

4. A method according to any of the preceding claims in which each blade is machined to a profile uniform along its total axial length but with its dimensions increasing towards the disc.

5. A method according to any of the preceding claims in which each blade at its end remote from the disc is provided with a pin machined on two of its sides surfaces by a turning operation and along its two other side surfaces during the operation of cutting the blade profile.

6. A method according to claim 5 in which a ring having recesses punched corresponding to the blade pins is applied to the blade ends and is attached to said blades by clinching the pins.

7. A method according to any of claims 1 to 4 in which each blade at its end remote from the disc is provided with a cylindrical pin machined by a drilling tool before the milling of the blade profile.

8. A blade wheel constructed according to any of the preceding claims.

9. A method of producing a blade wheel substantially as hereinbefore described with reference to the accompanying drawings.

FRANK WATSON & CO.,
Agents for the Applicants,
148/150 Holborn,
London E.C.1.

Sheerness: Printed for Her Majesty's Stationery Office, by Smiths, Printers and Duplicators.—1961.
Published at the Patent Office, 25 Southampton Buildings, London, W.C.2., from which copies may be obtained.

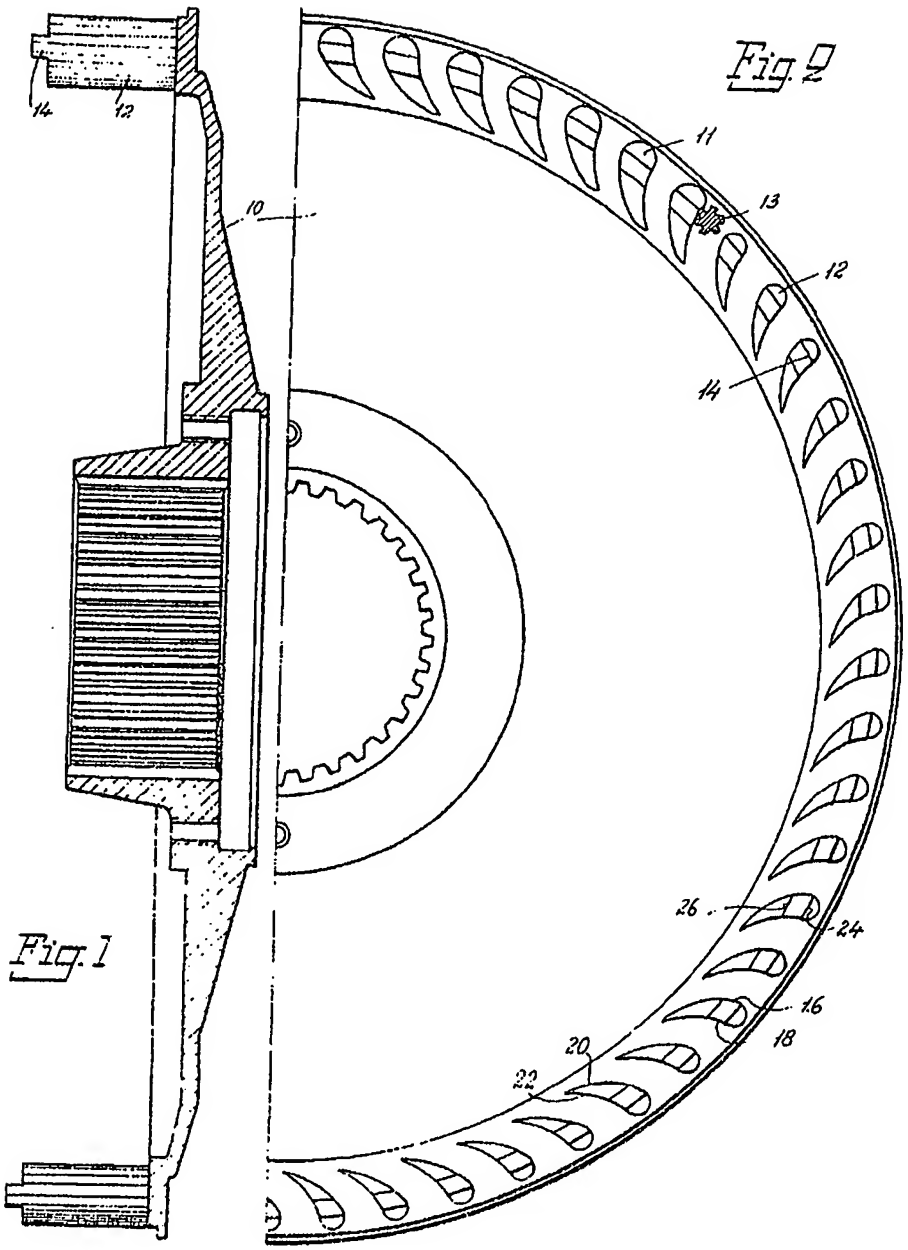


Fig. 1

Fig. 2

885,367 COMPLETE SPECIFICATION
2 SHEETS
This drawing is a reproduction of the Original on a reduced scale.
SHEETS 1 & 2

Fig. 2

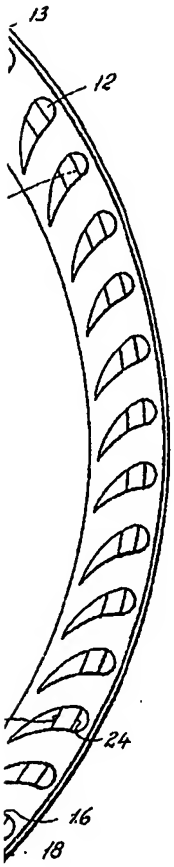


Fig. 3

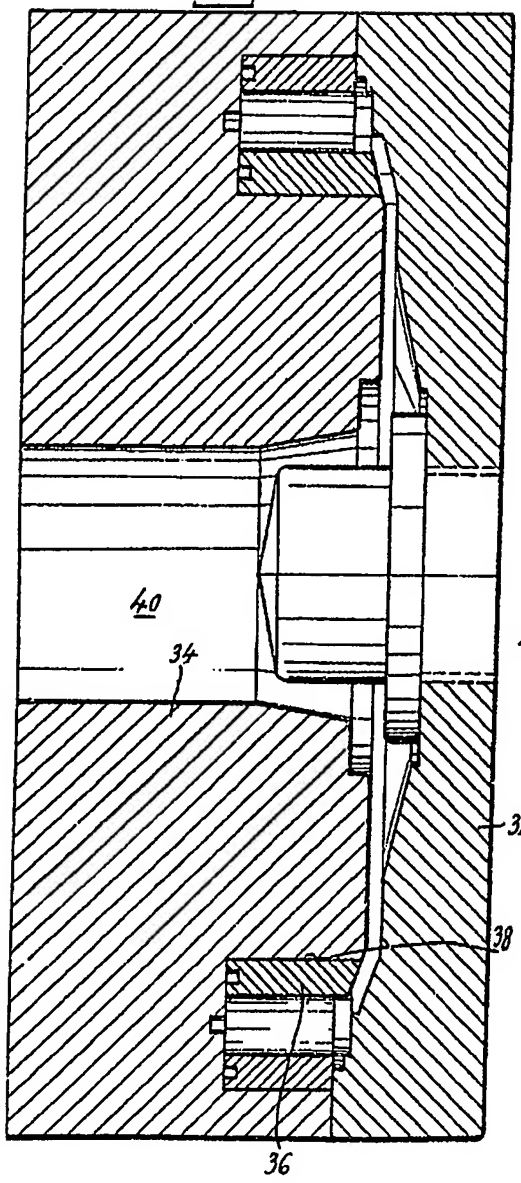
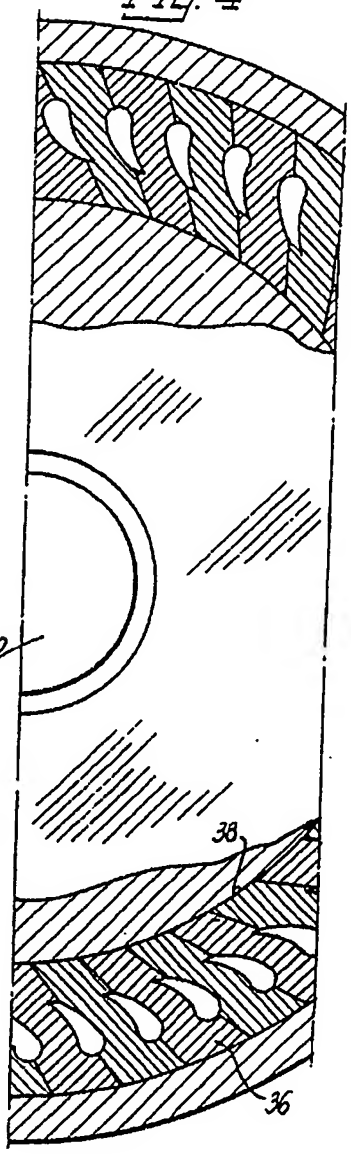


Fig. 4



885,367 COMPLETE SPECIFICATION
2 SHEETS

This drawing is a reproduction of the Original on a reduced scale.
SHEETS 1 & 2

Fig. 2

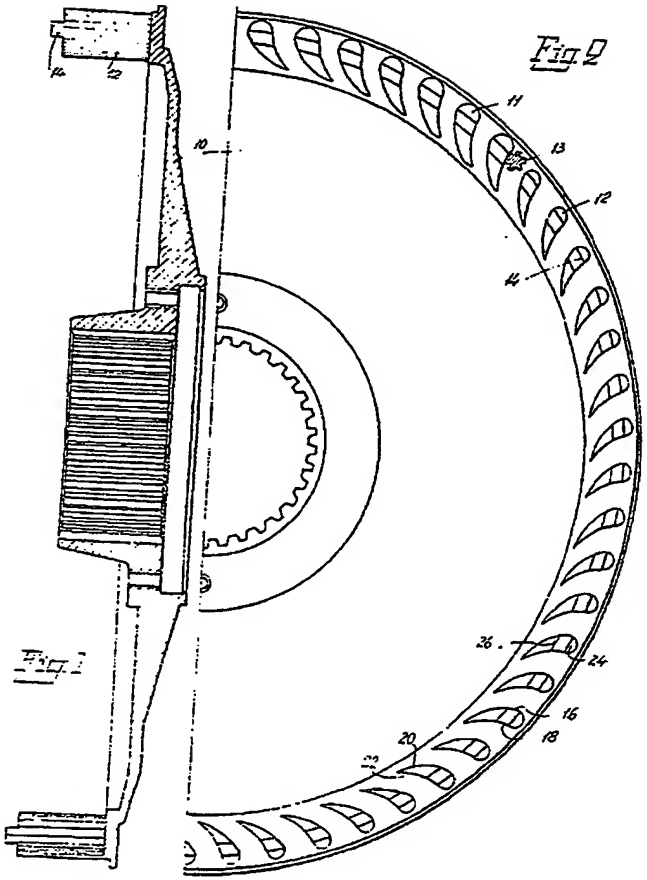


Fig. 1

Fig. 3

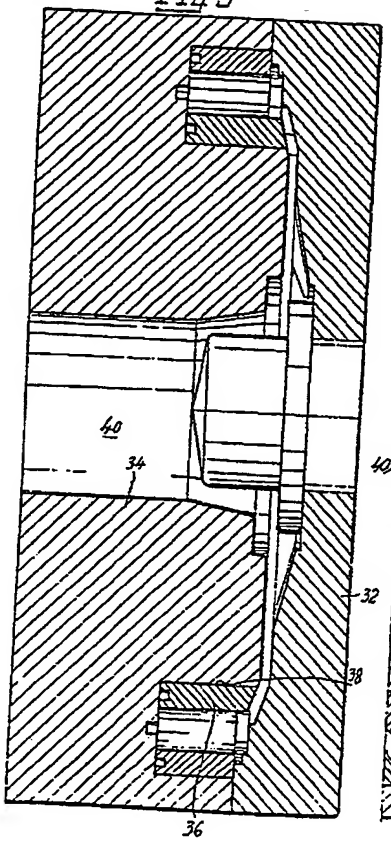


Fig. 4